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IN SITU CONSERVATION OF WILD FLORA RESOURCES

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INTRODUCTION

The Flora of India comprises about 45,000 species from unicellular cyanobacteria to the flowering plants which represents 11% of the known plant species of the world. In this spectrum, the flowering plants of India comprise about 15000 species and they form the dominant group and represent 6% of the world total (Nayar, 1977). This rich assemblage of plants in about 315 families and 2250 genera occur in different ecosystems from the humid tropics of Western Ghats to the alpine zones of the Himalaya and from the mangroves of tidal Sunderbans to the dry deserts of Rajasthan.

1.2. The Floristic composition of a region is a standing diversity of all taxa of plants and India has a genepool of 45,000 species. They are distributed in different taxonomic divisions as given in the table (Appendix I). Of the 15000 species of flowering plants, 33% are endemic and they are mainly located in 26 endemic centres of the country (Appendix II). There are about 141 endemic genera distributed over 47 families (Nayar, 1980). Of the 4900 endemic species, the Himalayas and adjoining areas represent 2532 species followed by Peninsular India with 1788 species and 185 endemics in the Andaman & Nicobar Islands. The family Poaceae, one of the largest, has about 360 endemic taxa (Jain, 1986). The endemic monotypic genus *Hubbardia* reported from the Jog Falls of Karnataka is extinct (IUCN Red Data Book). Of the 185 endemics in the Andaman & Nicobar Islands 75 species are tree species; 65 endemic species could not be collected even after repeated surveys. As per IUCN category, they are to be treated as "Extinct or Inderminate."

1.3. The ten families in Indian Flora represented by large number of species in the order of sequence are : Poaceae, Asteraceae, Orchidaceae, Fabaceae, Rubiaceae, Cyperaceae, Euphorbiaceae, Lamiaceae, Acanthaceae and Scrophulariaceae (Appendix I). Of the 15000 species of flowering plants, about 2560 species belong to the tree species and they predominantly occur in the following families : Lauraceae, Annonaceae, Rubiaceae, Moraceae, Rutaceae, Meliaceae, Palmae, Anacardiaceae, Sapindaceae, Clusiaceae, Sterculiaceae and Dipterocarpaceae whereas 41 families are represented by just one species each. The insectivorous families are represented by Droseraceae (3 spp.), Lentibulariaceae (36 spp.) and Nepenthaceae (1 sp.). The parasitic families are represented by Loranthaceae (46 spp.), Santalaceae (10 spp.), Balanophoraceae (6 spp.), Burmanniaceae (7 spp.), Rafflesiaceae (1 sp .) Mitrastemonaceae (1 sp.), Orobanchaceae (54 spp.) and Cuscutaceae

(12 spp.). Species of the family Chenopodiaceae, Amaranthaceae, Basellaceae, Phytolaccaceae are salt tolerant species. Metal tolerant species are found in the families Caryophyllaceae, Portulaccaceae, Tamaricaceae, Salvadoraceae, Thymelaeaceae and Fabaceae

1.4. The Indian subcontinent is one of the twelve world centres of genetic resources (Zeven and Zhukovsky, 1975). The cultivated plants which have originated in the subcontinent are as follows : Rice, black gram, green gram, moth bean, mango, jackfruit, black pepper, banana, citrus, jamun, brinjal, tinda, taros, bitter gourd, smooth gourd, ridged gourd, parval, ginger, turmeric, cardamom, sugarcane, jute, coconut, sunhemp and several species of bamboos.

1.5. There are 16 major forest types and they in turn comprise 221 minor forest types (Champion & Seth, 1968). Tropical moist deciduous forest type forms the major forest cover (37%) followed by the tropical dry deciduous forest (28.6%). The tropical wet evergreen forest has an area of 51,249 sq.km which is only 8% of the forested area (Appendix III).

1.6. Several phytogeographers (Hooker, 1906; Clarke, 1898; Chatterjee 1940; Rao & Razi, 1974) classified botanical provinces on the basis of floristic composition and affinities. The modified version recently proposed by Rodgers & Panwar (1988) on the biogeography is as follows : (i) Trans Himalayan, (ii) West Himalayan, (iii) East Himalayan, (iv) Desert, (v) Semi arid, (vi) Western Ghats, (vii) Deccan Peninsula, (viii) Gangetic plain, (ix) North-east India, (x) Islands, (xi) The Indian coast.

2.1. *Trans Himalayan zone* : The trans Himalayan zone forms the cold desert of India and is the most distinct zone covering Ladakh in Jammu & Kashmir and Spiti deserts of the Himachal Pradesh. The important species are *Juniperus communis, Podophyllum emodi, Polygonum affine, Ephedra gerardiana, Myricaria elegans, Saussurea subulata*. Species of *Juniperus* (*J. wallichiana* and *J. communis*) rarely reach a metre high. The important wild genetic resources are several species of *Allium* and *Cicer soongaricum*. The existing protected areas cover only 0.4% of the area (Rodgers & Panwar, 1988). The floristic areas which require protection are Numkun, Siachenshyok, Chang-Chenmo in Ladak areas and North Spiti in Lahul Spiti.

2.2. *The Western Himalaya* : The Western Himalaya constitutes subtropical, temperate, subalpine and alpine forest types. They hold about 4800 species of which 430 species are endemic to the region. The important tree species of mixed deciduous forests are *Tectona grandis, Butea monosperma, Albizia procera, Terminalia tomentosa, Dalbergia sissoo, Grewia oppositifolia* and *Holoptelea integrifolia*. The broad leaved temperate forests are dominated by *Quercus* species (*Q. leucotrichophora* in lower reaches, *Q. lanuginosa* in alt. between 1800-2200 m and *Q. semicarpifolia* in higher altitudes). Important tree species of moist temperate broad leaved deciduous forests are *Juglans regia, Ulmus wallichiana, Aesculus indica, Salix disperma, Morus alba*. The principal species of temperate conifer forests are deodar (*Cedrus deodara*), Silver fir (*Abies pindrow*), Spruce (*Spicea smithiana*). Some of the ornamental plants come from the genera *Anemone, Epilobium, Geranium, Gentiana, Meconopsis, Bergenia* and *Primula*. Species of *Agropyron, Brachypodium, Bromus, Poa* and *Festuca* form excellent pastures. Important medicinal plants belong to species of *Sorbus, Caragana, Berberis, Picrorhiza*, etc.

2.3. *Eastern Himalaya* : The Eastern Himalaya comprises Sikkim and Arunachal Pradesh and this is the richest floristic province of India. There are about 7500 species of which about 1200 species are endemic. The north east India is one of the centres of origin of *Musa* and *Citrus.* The wild bananas with basic chromosome number 2n = 18, 20, 22, 24 are found growing wild in the hills of Eastern Himalaya.

There are 189 species of wild relatives of crop plants. The family Orchidaceae has the largest representation of species (*i.e.* 700 species out of the total of 990 species).

The mountain slopes are covered by a variety of colourful Rhododendrons (80 spp.). The region is rich in bamboos and canes. The common bamboo species are *Chimanobambusa griffithiana, Cephalostachyum latifolium, Dendrocalamus hookeri, Phyllostachys bambusoides* (climbing bamboo) and *Dendrocalamus sikkimensis.* The tropical evergreen forests have tall trees of *Dipterocarpus macrocarpus, Artocarpus chaplasha, Shorea robusta* and *Tetrameles nudiflora.* Important timber yielding trees are *Shorea assamica* and *Terminalia myriocarpa.*

The subtropical forest has an association of *Schima — Castanopsis — Engelhardtia* association in the higher regions. *Schima wallichii, Castanopsis indica, Exbucklandia populnea* are common species. Among the palm species, *Livistona jenkinsiana, Wallichia caryotioides, Calamus erectus, C. floribundus* are important. The temperate forests consists of the following forest sub-types :

(i) Temperate broad leaved forests (*Acer campbellii, Corylopsis himalayana).*

(ii) Evergreen oak forests (*Quercus spicatus, Castanopsis hystrix, Juglans regia, Magnolia campbellii, Michelia doltsopa*).

(iii) Temperate Rhododendron — conifer forests: Some of the species which are of ornamental value are Rhododendrons (*R. hodgsonii, R. campanulatum*) and species of *Primula, Meconopsis, Pedicularis,* etc. Several ornamental species belonging to *Anemone, Corydalis, Draba, Potentilla, Saxifraga, Sedum, Cortia, Nardostachys, Cremanthodium, Anaphalis, Cassiope, Androsace, Lagotis* form alpine flora. Eastern Himalayan flora abound in plant relicts and ancient primitive flora. The important and perhaps the most primitive ancient angiosperm is *Magnolia pterocarpa.* The primitive angiosperms are *Magnolia griffithii, Tetracentron sinense, T. sinense* var. *himalayense.*

It is necessary to develop *in situ* genepools of the following groups of flowering plants : *Magnolia, Citrus, Primula, Rhododendron.*

2.4. *Desert* : The Indian desert occupies 6.8% of the land surface of the country and the important life support species are *Prosopis cineraria* (Kejari), *Acacia nilotica, Salvadora oleoides, Capparis decidua, Ziziphus nummularia, Citrullus colocynthis, Crotalaria burhia.* Important salt tolerant species are *Holoxylon recurvum, Salsola baryosma, Tamarix indica, Suaeda fruticosa, Atriplex stocksii, Sesuvium sesuvioides.*

2.5. *Semi-arid zone* : The vegetation is primarily of tropical thorn forests. The most characteristic species are *Capparis decidua* and *Prosopis spicigera.* The characteristic grasses are *Lasiurus hirsutus* and *Panicum turgidum.* The important trees are *Anogeissus latifolia, Diospyros melanoxylon, Boswellia serrata, Acacia senegal, Balanites aegyptiaca.*

2.6. *Western Ghats* : There are about 4000 species of flowering plants (Subramanyam & Nayar, 1974; Nair & Daniel, 1986) of which 1500 species are endemic. The conifer *Podocarpus latifolia* is confined to the hills of Tinnevelly.

Dominant associes of tree species are : *Vateria — Cullenia, Vateria — Mesua, Poeciloneuron — Palaquium, Poeciloneuron — Dipterocarpus, Cullenia — Mesua, Vateria — Elaeocarpus.* Several tree species of commercial value are : *Tectona grandis,* *Terminalia crenulata, Dalbergia latifolia, Dipterocarpus indicus,* etc. Giant trees with buttressed roots and straight boles are common as in species of *Dipterocarpus, Hopea, Mesua, Poeciloneuron* etc. Some of the common palms are *Arenga wightii, Caryota urens, Pinanga dicksonii.* Important plants of genetic resources are *Elettaria, Myristica, Piper, Aroids, Oryza.* The bamboo forests or "Breaks" consists of *Bambusa arundinacea, Dendrocalamus strictus, Oxytenanthera* sp. The Western Ghats are rich in orchids.

2.7. *Deccan Peninsula :* The important dominant species of commercial timber value are *Tectona grandis, Shorea robusta,* species of *Anogeissus, Terminalia, Diospyros, Boswellia* and *Hardwickia binata.* The wild species of *Atylosia cajanifolia, Musa balbisiana, Oryza jeyporensis, O. malampuzhaensis, Shorea tumbaggaia* have the potential of germplasm value for the future. The germplasm sites are Ganjam-Koraput, Panchmarhi-Satpura, Araku Valley, Nallamalais, Cudappah-Tirupati and Shevaroy hills.

2.8. *Gangetic Plains:* The flora is typically of terai at the southern fringe of the Himalayan foothills and dense scrub jungles. The important life supporting species of timber value are *Dalbergia sissoo, Shorea robusta, Anogeissus pendula, Acacia senegal.* The grasses are tall with species of *Themeda, Saccharum* and *Phragmites.*

2.9. *North East India :* About 50% of India's total number of species, *i.e.* 7500 species occur in this region. The area is considered as the 'cradle of flowering plants' as many primitive plants (*Magnolia pterocarpa, M. gustavi, Decaisnea, Parvatia, Talauma hodgsonii*) occur in this region. Out of the 990 species of orchids, 700 species occur in the north east including E. Himalaya.

There are 34 species of *Hedychium* compared to the world total of 60. This region is also very rich in *Citrus.* There are 64 taxa of *Citrus sinensis, C. reticulata, C. media, C. aurantium, C. nobilis, C. limonia* both as wild and cultivated forms. Other important plants of genetic resources are : *Coix lacryma-jobi, C. gigantea, Oryza rufipogon, Polytoca wallichiana, Moghania vestita, M. bracteata, M. umbellata, Atylosia barbata, Canavalia ensiformis, Artocarpus* spp. *Fragaria indica, Myrica esculenta, Prunus acuminata, Pyrus pashia, Ribes graciale, Docynia indica, Mangifera sylvatica, Musa acuminata, M. velutina* and *M. superba.*

Some of the medicinal plants which are used locally are *Rheum emodi,* Mishmi teeta (*Coptis teeta*), Croton oil (*Croton tiglium*).

Important timber yielding trees are *Dipterocarpus macrocarpus, Artocarpus chaplasha, Shorea robusta, S. assamica* and *Terminalia myriocarpa.* The common bamboo species which are economically important for the local people are *Dendrocalamus hamiltonii, D. giganteus, Chimanobambusa khasiana, Bambusa tulda, Melocanna bambusoides.*

2.10. *Islands :* The Andaman & Nicobar group of islands which consists of 348 islands having 8,327 sq.km area support 2200 species of higher plants. The endemism is in the range of about 9%. The flora is unique in having large number of tree species which are endemic. There are about 185 endemic species of which 75 species are tree species (Balakrishnan, 1977).

The dominant species and economically valuable timber species are *Dipterocarpus grandis* and *D. kerri. Pterocarpus dalbergioides* grows to 50 m with huge buttresses. Other important trees are *Albizia lebbeck, Terminalia bialata, Canarium aphyllum, Ailanthus kurzii.* Among the canes, *Calamus viminalis* is dominant.

The discovery of a wild rice *O. indandamanica* described by Dr. Ellis of the BSI from Saddle Peak is an important genetic resource. Species which can be commercially exploited are *Myristica andamanica, Baccaurea sapida, Knema andamanica,* several wild species of banana (*Musa*), wild citrus, mango (*M. comptosperma*), edible fruits of species of *Garcinia.*

The life supporting species : *Pandanus learum, Nypa fruticans* and *Artocarpus chaplasha.*

Mangrove forests along the coasts are dominated by *Rhizophora mucronata, R. conjugata, Bruguiera gymnorrhiza, Avicennia marina, A. alba* and *Nypa fruticans.* A carnucopia of useful plants are awaiting discovery in this small group of islands.

3. "Hot Spots" of Wild Flora

3.1. The three "hot spots" of wet humid tropic forests which require conservation, protection participative biodiversity involvement are of Andaman & Nicobar islands, Eastern India and Southern W. Ghats. Considering the different biomes of the Indian subcontinent, the wet evergreen forests of India which occupy51,249 sq. km of area hold about 7000 species which is 46% of Indian flora, though represent only 1.5% of India's land surface. In the spectrum of world distribution of wet evergreen forests which occupy 6% of the earth's surface, having about 90,000 species of higher plants (*i.e.,* 36% of world species), the concentration of about 7000 species in 1.5% of India's land surface forms a great risk factor as the tropical forests are biologically and ecologically complex and they are more fragile than temperate ecosystems and have been described "Tropical forests are in constant turmoil of phasic development .... and they are stable only within a relatively small domain of parameter space" (Unesco, 1978). The rich biodiversity of tropical forests can be understood by the knowledge that the 8952 hectares (90 sq.km) of Silent Valley supports about 1000 species of vascular plants. Ashton (1981) documented 700 species of trees in 10 one hectares in Borneo. The La Seva Forest Reserve of Costa Rica supports 1800 vascular plants, 394 species of birds, 104 mammals, 76 reptiles, 42 fish and 143 butterflies.

Great Nicobar which has an area of 1045 sq.km was surveyed up to the extent of 40% (Balakrishnan, 1979) and 771 species of flowering plants were collected in an area of 520 sq.km. The rich floristic diversity is unique. The following areas which are endemic centres are "hot spots" of floristic diversity.

Andaman & Nicobar Islands :

Islands due to interference by man have become death traps of species. "The vast majority of island biota are however, at the present time under serious pressure from the activities and influence of man who is destroying their natural ecosystems at an alarming rate. It is extremely doubtful if we will ever arrive at an alphataxonomy state of knowledge of some insular floras before catastrophic numbers of endemic island plants and animals become extinct" (Bramwell 1979). On the basis of endemic species genetic resource floristic diversity the following "hot spots" are identified.

(i) N. Andaman ridge, N. Andaman Peninsula, Saddle Peak, Table Islands, Sir Huge Ross Island, Interview Island, South Reef Island, Mount Diavolvo, Narcondam Island, Barren Island, Spike Island, South Sentinal Island, Little Andaman — Kamorta Island, Little Nicobar, Megapode Island, Great Nicobar (Mt. Thullier), Tillanchong Island.

Eastern Himalayas & Eastern India :

The eastern gateway with the high Himalayan mountain chain in the north and Khasia-Jaintia hills in the south and Lushai hill in the south east and Nagaland mountains in the east drained by the Brahmaputra is a crucible of floristic diversity and genetic resources. This area is considered alongwith Yunnan as the "Cradle of flowering plants" and it supports about 7500 species, nearly 50% of India's flowering plants. The floristic diversity centres are seen in several valleys and mountain ecological niches. Some of the areas identified are as follows.

Neora Valley, Buxa Valley, Senchal, Singalia, Dzongri, Pangola, Tolung, Khangchendzonga, Singba, Tawang, Lado, Tale Valley, Dibang Valley, Walong, Namdapha, Tirap, Siroi, Dzuko, Keibul-Lamjao, Nongkhlaw, Mawsmai, Rongrengri, Tura, Dampa, Twai, Palak, Murlen, Palak.

Southern W. Ghats: The Southern W. Ghats known as the floristically rich "Malabar" is a genetic resource of several species of Pepper, *Oryza, Myristica, Elettaria, Costus, Garcinia, Cinnamomum, Colocasia, Amorphophallus, Andropogon, Amomum, Atylosia, Canavalia, Curcuma, Dioscorea, Cymbopogon, Glycine, Panicum, Phaseolus, Vigna, Zingiber.*

Some of the areas where these species of wild relatives of cultivated plants occur are Wyanad, Silent Valley, Parambikulam, Anamudi, Bevikulam, Agastyamalai, Palni hills, Mudumalai, Boluvampatti, Megamalai, Kalakad, Keenaparai, Shevaroy, Nagarhole, Talakaveri, Brahmagiri, Kudremukh with several pockets of floristic diversity.

4. An overview of Life support species

For a country of India's size with a vast spectrum of ecological niches and having about 45,000 species, the use of a few species for food, medicine, clothing and habitation is antitheses of the long term sustainable use of our resources. Besides with a mosaic of ethnic cultures and traditional practices, there is scope of utilisation of less known uses of plants and appropriate harvesting of traditional uses aided by modern scientific skills. India has a rich germplasm of 120 species of bamboos but many species are facing extinction because of over exploitation of bamboos for uses. It is accepted that genetic diversity and biological variability are important components for sustainable use of our crops. It is well known that one population of *Oryza nivara* occurring in India provided the Grassy stunt virus resistance in rice and another *Oryza* sp. occurring in Kerala provided resistance to the blast disease. The new species of *Oryza indandamanica* Ellis discovered from Andaman may become useful as of *Zea perennis.*

Life Support tree species :

Life support wild tree species which have multipurpose use in the tropics are several species of *Artocarpus chaplasha, Tetrameles nudiflora* (Yeremel), *Gmelina arborea, Madhuca latifolia* (Mahua tree), *Sesbania grandiflora, Ficus cunia* (fruit), *Ficus fistulosa* (fruits & leaves as fodder), *Ficus glaberrima, Ficus semicordata, Grewia optiva, Moringa, oleifera, Mesua ferrea, Pterospermum acerifolium.*

Life Supporting fodder trees:

Besides several species of *Ficus* which are used as fodder some other species that are readily used are *Ailanthus excelsa,* species of *Acacia* and *Prosopis, Albizia lebbeck, Sesbania bispinosa,* and some of the mangroves.

There are several less known economically important oil yielding species and where more research effort is required. Some of the common weedy species which can yield oil for industrial uses are *Jatropha curcas, Impatiens subcata* (edible oil) and several species of *Euphorbia.* As pot herb Choru (*Angelica glauca*), Man dhanica (*Eryngium foetidum*), Wattakakodi (*Wattakaka volubilis*), Phang (*Rivia hypocrateriformis*), Phran (*Allium humile*), *Begonia floccifera* (Elephant's ear), *Gnaphalium luteo-album* (Tipitens), *Gynura crepidioides* (Uti), *Oxyspora paniculata* (Sanai), *Solanum kurzii* (Bak) (fruits), *Clerodendrum colebrookianum* (leaves) are used.

Diplazium esculentum — edible fern (Dhenk Sag) — The terminal parts of curled fronds are cooked as an edible vegetable which are fleshy and tasty. There is an urgent necessity to grow this species commercially and tribal folks use this as a

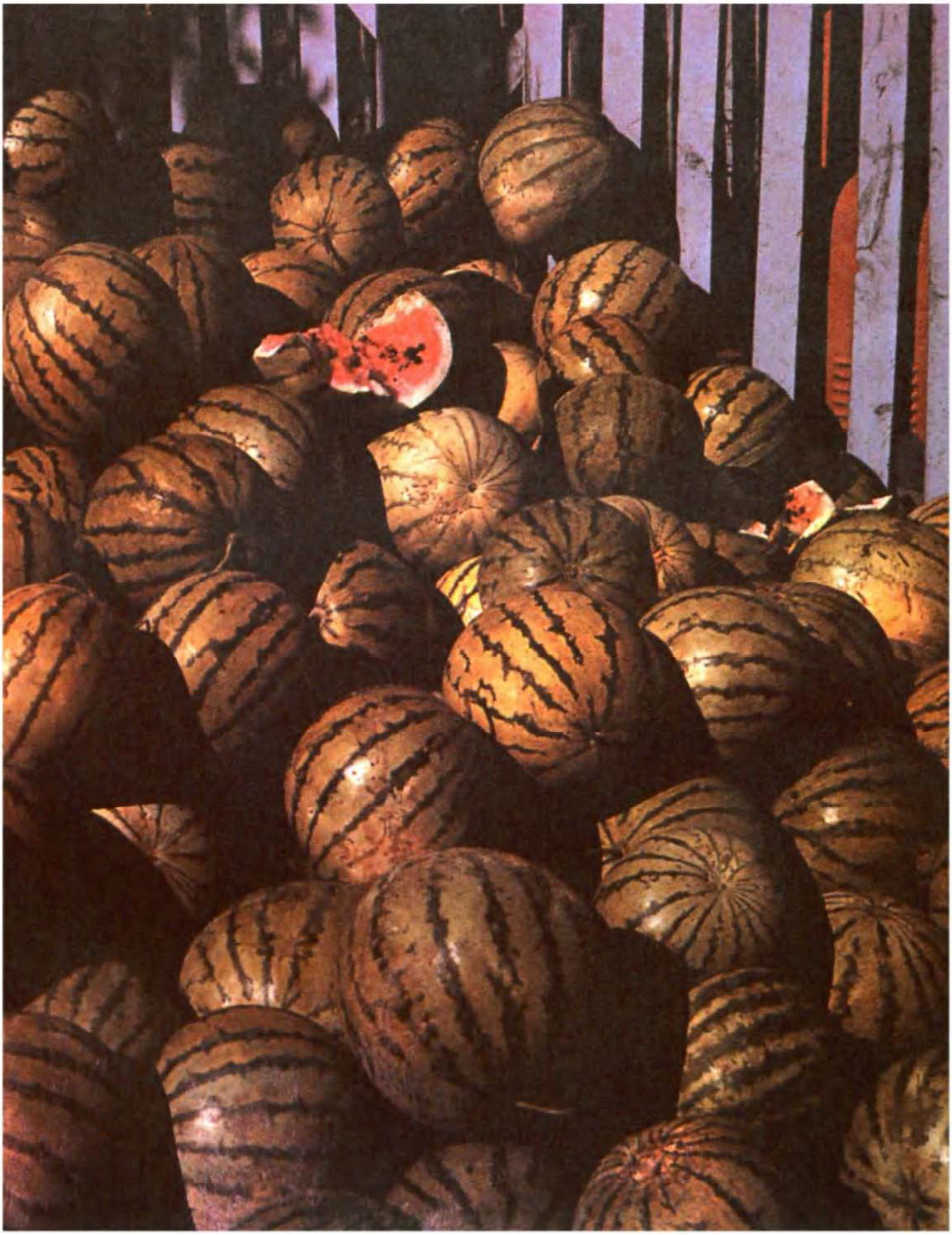
A lush evergreen forest system

Quarrying for industries

Mangroves in Andamans

A variety of genetic resources of vegetables in rural markets

Mangrove Palm "*Nypa fruticans*"



Water melon "*Citrullus vulgaris*"

daily article of food.

Diplazium asperum (Lingora) — The young fronds are edible. The agronomic trials and study and ecological aspects require details.

Prosopis cineraria (Khejri) — The leaves and young shoots are used as vegetable. The tender pods are known as Sangri and cooked as vegetable.

An All India Coordinated Project on Ethnobotany indicates that out of 2000 or more wild plants used as edibles, 500 are found to be new information and 7000 wild plants used by tribal ethnic cultures, 3000 wild species are used for medicinal purposes.

There is a vast reservoir knowledge available on several less known useful plants and it is necessary to dovetail this knowledge with further research efforts for understanding their agricultural requirements, genetic structure and methods of propagation. Unless these efforts are done immediately, the vast array of genetic resources would be driven to the wall.

5. Sustainable Management of *in Situ* Conservation of Wild Flora

5.1. The network of national parks, sanctuaries cover 3% of the country and they are our *in situ* protected areas by law. It is understood that there are proposals for increasing the protected area network to 4.6% area of the country. *In situ* protection is genetic-wise pure and more safe than *ex situ* conservation and also costwise less expensive, and is preferable to preserve and conserve biological diversity. The 13 biosphere reserves identified for the country takes care of the different biomes, with a core area protection by law and buffer zone sustainable development by different agencies involving the local people. The 7 biosphere reserves (Nilgiri, Nandadevi, Sunderbans, Gulf of Mannar, Manas, Nokrek and Great Nicobar) notified by the Ministry of Environment & Forests has given a new thrust in the scientifically managed conservation programme of the flora and fauna.

5.2. As land is a precious non-stretchable resource, it is necessary to insulate land from "development" pressures by declaring as 'wilderness sites', 'village commons', 'secred forests', 'heritage sites' in vicinity of every village, town and agricultural systems. It is also worth considering converting 5% of our agricultural lands with 'wilderness genetic resources', as plants have a remarkable capacity to colonise, perennate and multiply with their seed banks.

5.3. Since preservation of floristic diversity is a matter of insurance and investment for our agriculture and forestry system, it is necessary to keep as many options open as *ex situ* preservation is costwise prohibitive and genetic purity wise not safe. According to Ashton (1987) "the average annual cost of maintenance for each individual woody plant grown in the Arnold Arboretum is 64 dollars; population samples of 50 individuals would cost 3200 dollars annually; could not most be conserved *in situ* cheaply ?" Peter Raven (1981) states : "Unfortunately such collections are often dismantled or simply deteriorate after the specialists who built them up are no longer active at the respective institutions. Although they are often of great value internationally; they may if they are not actively utilized come to be viewed as a drain upon the limited resources of the institution they are housed.

6. The Endangered Plant Species of India

In India out of 15,000 species of flowering plants, 1500 are evaluated in various categories of threatened species *i.e.* 10 per cent of Indian flora. Out of 11,300 species of higher plants in Europe, 1927 species come under threatened, out of which 117 species are endangered and 20 species are extinct. Of the 20,000 species in USA and Canada, 2150 species are threatened. In India, the species loss is maximum in tropical forests. As tropical forests occur only in 1.5% of total land area, the loss is maximum due to fragmentation of germplasm leading to loss of habitat, following the synthetic theory of island biography. Out of an analyses of the 427 endangered species (Nayar & Sastry, 1987, 1988) it is seen 28 species are presumed extinct, 124 endangered, 81 vulnerable and 160 rare and 34 insufficiently known. In Andaman & Nicobar Islands, about 65 endemic species which are mostly trees could not be relocated in the recent times. Raven (1986) mentions that 60,000 species of higher plants are likely to become extinct by the year 2050. During the last fifty years, in India 93 species could not be relocated. By the turn of the century unless the habitat loss and population pressure is contained, we may have to say good bye to another 100 species, as the loss of species will be at geometrical rate.

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Table 1

APPENDIX I

Species number in the major plant groups in India & World

Kingdom		Division	Approx. no. of species in India	Approx. no. of species in the World
Monera	Bacteria	Bacteria including Cyanobacteria	850	2,700
Fungi			23,000	100,000
Protista	Algae (including water & saline moulds)		2,500	22,050
Plantae	Bryophyta	Liverworts, Mosses & hornworts	2,564	160,000
	Psilopsida	Psilopsids	12	several
	Lycophyta	Clubmosses	103	10,00
	Sphenophyta	Horse tails	7	30
	Pteridophyta	Ferns	900	12,000
	Coniferophyta	Conifers	55	550
	Cycadophyta	Cycads	5	100
	Ginkgophyta	Ginkgo	0	1
	Gnetophyta	Gnetum	4	70
	Anthophyta	Flowering Plants	15,000	250,000

Ten large families in India

Name of the Family	Number of genera	Number of species
Poaceae (Gramineae)	255	1,225
Asteraceae (Compositae)	161	1,000
Orchidaceae	145	990
Fabaceae	123	775
Rubiaceae	90	495
Acanthaceae	84	379
Euphorbiaceae	74	419
Lamiaceae (Labiatae)	68	393
Scrophulariaceae	66	353
Rosaceae	31	217

APPENDIX II

Table 1

ENDEMIC CENTRES

1. Karakoram & Ladak of Kashmir Himalayas
2. Kumaon — Garhwal Himalayas
3. Siwaliks
4. Terai
5. Sikkim Himalaya
6. Arunachal Pradesh of E. Himalaya
7. Lushai hills
8. Tura-Khasi hills
9. Aravallis
10. Chotanagpur plateau
11. Panchmarhi-Satpura ranges
12. Similipal & Jeypore hills of Orissa
13. Bastar & Koraput hills
14. Vizagpatnam hills & Araku Valley
15. Tirupati-Cuddappa hills
16. Marathwada hills
17. Saurashtra-Kutch
18. Mahabaleshwar— Khandala ranges of W. Ghats
19. Agumbe-Phonda ranges of W. Ghats
20. Ratnagiri & Kolaba ranges of W Ghats
21. Nilgiris, Silent Valley & Wynaad
22. Anamalais of W. Ghats
23. Palni-Yercaud
24. Kalakad & Agastyamalai, hills of W. Ghats
25. Andaman Islands
26. Great Nicobar Island.

Table 2

Country	Species richness	Area	Diversity
United Kingdom	18,00	244,754 sq.km.	334
Italy	48,00	251,447 "	888
Albania	32,00	28,748 "	717
Zaire	11,000	2,345,410 "	1726
Tanzania	10,000	939,762 "	1674
Uganda	5,000	236,578 "	930
India	15,000	3,280,483 "	2304

APPENDIX III

The occurrence of various forest types in the country, as based on the interpretation of Landsat imageries of 1981-83 is :

Sl. no.	Forest Type	Area in sq.km	Percentage
1	2	3	4
1.	Tropical Wet Evergreen Forest	51,249	8.0
2.	Tropical Semi-Evergreen Forest	26,424	4.1
3.	Tropical Moist Deciduous Forest	236,794	37.0
4.	Littoral and Swamp Forest	4,046	0.6
5.	Tropical Dry Deciduous Forest	186,620	28.6
6.	Tropical Thorn Forest	16,491	2.6
7.	Tropical Dry Evergreen Forest	1,404	0.2
8.	Sub-Tropical Board Leaves Hill Forest	2,781	0.4
9.	Sub-Tropical Pine Forest	42,377	6.6
10.	Sub-Tropical Dry Evergreen Forest	12,538	2.5
11.	Montane Wet Temperate Forest	23,365	3.6
12.	Himalayan Moist Temperate Forest	22,012	3.4
13.	Himalayan Dry Temperate Forest	312	—
14.	Sub-Alpine and Alpine Forest	18,628	2.9